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OBSERVATIONS ON SURFACE-RELEASED, SUBLEGAL SPINY LOBSTERS, AND POTENTIAL SPINY LOBSTER PREDATORS NEAR NECKER AND NIHOA ISLANDS

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BACKGROUND

The Insular Resources Task of the Southwest Fisheries Center Honolulu Laboratory is engaged in an extensive survey of the fishery resources of the Northwestern Hawaiian Islands (NWHI). Several projects within the task are directed towards various aspects of spiny lobster, Panulirus marginatus, biology, including distribution, abundance, size composition, growth rate, sexual maturation, and fecundity. These and other data will be the basis of a Fishery Management Plan (FMP) for the developing spiny lobster fishery in the NWHI. Under existing Hawaii law, it is illegal to take berried and undersized spiny lobsters, and lobster fishermen are required to return them alive to the sea after removal from the traps. If the lobsters are released at the surface, they must swim to the bottom at depths which range from approximately 20 to 80 m. Large carangids (probably more than one species) have been observed preying on such surface-released spiny lobsters. Sharks of several species may also be possible predators. Various carangids and shark species are common on the spiny lobster fishing grounds of the NWHI and frequently are numerous around fishing vessels. To determine if regulations governing the way "illegal" spiny lobsters should be returned to the bottom should be written into the FMP, the Western Pacific Regional Fishery Management Council has requested that the Honolulu Laboratory design and conduct experiments to determine the extent of the predation problem and, if the degree of predation warrants, develop and test release procedures that will allow the largest possible percentage of released lobsters to reach the relative safety of the ocean floor.

OBJECTIVE

During the last section of Townsend Cromwell cruise 79-02 (May 27-June 6), observations were made on spiny lobsters and slipper lobsters, Scyllarides squammosus, which were released at the surface from the vessel, and from a bag which had been lowered to the bottom (Table 1). The objectives of the experiments were to determine: (1) The probability of lobsters safely reaching bottom when they are freely released from the surface when potential predators are present, and (2) the vulnerability of lobsters to potential predators when they are released from a bag on the bottom. In addition we anticipated that the observations would provide data on species and size of fishes which might prey on lobsters, and the relationship between lobster size and predator success.

Table 1.--Itinerary of the Townsend Cromwell during spiny lobster predation experiments.

Date 1979	Activity
May 29	- Arrived Necker Island; set lobster traps.
30	- Hauled traps. Conducted lobster release experiments, and made underwater observations 1 mile south of Necker Island.
31	- Hauled traps. Conducted lobster release experiments and made underwater observations 3 miles south of Necker.
June 1	- Hauled traps and made surface observations of released lobsters 4.5 miles northeast of Necker.
2	- Hauled traps. Conducted lobster release experiments and made underwater observations 5 miles northwest of Necker.
3	- Hauled traps. Conducted lobster release experiments and made underwater observations 0.25 mile west of Necker.
4	- Conducted lobster release experiments and made underwater observations 0.2 mile south of Nihoa.

PROCEDURE

The general procedure was: After hauling the traps in the morning, the ship was anchored in a suitable area for the lobster predation experiments. The protective cage was then lowered into the water from the boom and held about 10 ft below the surface. Two underwater observers with a 16-mm movie and Nikonos 35-mm camera then entered the water and descended with the cage to a predetermined depth. On signal from the diver-observers, the surface observers released lots of six lobsters, put over the release bag containing about 20 lobsters, raised or lowered the cage, etc. A "Zodiac" with operator and standby diver maintained position over the underwater observers. The standby diver, with a look-box to monitor the underwater operation, received the signals. The ship-based observers recorded all events that were visible to them from the surface. At the termination of the observational dive (usually determined by air supply or film supply in the movie camera) the divers signaled that they were surfacing.

RESULTS

General Operation

The success of this project largely depended on three factors: (1) The feasibility of handling the cage from the ship, and of underwater observers being able to utilize the cage if required; (2) the availability of sublegal lobsters for use in the experiments; and (3) the successful location of suitable areas where potential predators were present.

Successful deployment and utilization of the cage was dependent on sea and current conditions. During the observations seas ran up to about 2 ft with moderate swells. At times currents of 1 knot or more made it difficult for the divers to maintain position in the vicinity of the cage, make visual observations, and operate the cameras. However, for the most part, the prevailing sea conditions were not limiting to the operations. The vessel's roll did sometimes jerk up and lower the cage over a range of about 5 ft. If shark behavior had made it necessary to routinely use the cage, it would have been necessary to suspend the cage from a buoy at the surface to eliminate the vertical surge from the vessel's roll. As it was, it was not necessary to enter the cage for protection.

The trapping sets were quite fruitful and there was no lack of suitable undersized and berried lobsters for the experiments.

Only the failure to locate areas with substantial numbers of large carangids was limiting during this cruise.

Observations

Table 2 lists the eight observational dives that were made during the cruise. Total underwater time was 148 min. We were able to make underwater observations of surface released spiny lobsters in the presence of several fish species which could be considered potential predators on lobsters: galapagos shark, Carcharhinus galapagensis; gray reef shark, Carcharhinus menisorrah; reef whitetip shark, Triaenodon obesus; white ulua, Caranx ignobilis; omilu, Caranx melampygus; and another ulua, probably Carangoides ferdau.

The lobsters used in the experiments had carapace lengths ranging from about 6.8 to 8.1 cm. On dive No. 1 there were no predators in the area. Four lots of spiny lobsters were released at the surface. The lobsters did not swim to the bottom but fell with their tails curled. On reaching the bottom, they aggregated into small groups on the flat sandy substrate which afforded very little shelter.

Table 2.--Observational dives.

Date 1979	Dive No.	Location	Bottom depth (ft)
May 30	1	1 mile south of Necker	75
31	2	3 miles south of Necker	80
June 2	3	5 miles northwest of Necker	115
2	4	0.25 mile west of Necker	75
3	5	0.25 mile west of Necker	75
3	6	0.25 mile west of Necker	75
4	7	0.2 mile south of Nihoa	65
4	8	0.2 mile south of Nihoa	65

During dive No. 2 there was a 2.2-m galapagos shark swimming in midwater and several jacks, omilu and probably Caranx ferdau on the bottom. Four lots of spiny lobsters were released from the surface. The shark was quite curious about the general operation and the divers but displayed no interest in the lobsters which sometimes passed within 10 ft of it. The lobsters landed on the bottom among the carangids which swam over to investigate but did not touch the lobsters.

Following the underwater observations on dive No. 2 we learned a little more about this particular shark's feeding habits. While the vessel remained at anchor, twice we baited a shark hook with a whole wrasse, Bodianus bilunulatus. The shark readily took the bait, managing to evade capture both times. We then baited the hook with a whole spiny lobster, which the shark would not touch, then with a lobster tail with the same result. The hook was finally baited with a piece of ulua and the shark was caught. Its stomach contained only the two wrasse it had stolen from the hooks. The evidence certainly indicates that even this moderately large and apparently hungry galapagos shark would not prey on spiny lobsters.

On dive No. 3 two lots of spiny lobsters were released. No predators were around, and no useful data were collected.

On dive No. 4 there were numerous omilu (45-60 cm) near the bottom. The bottom release bag (palu bag) weighted with several links of chain weighing about 20 lb and containing 20 spiny lobsters was lowered to the bottom. When the line was jerked to release the slip-knot the bag was lifted up off the bottom and dropped several times, but the bag did not open and we could hear the heavy chain crunching down on the lobsters. When the bag was being raised it opened about 25 ft from the bottom releasing numerous damaged lobsters, their antennae and legs. Three lots of spiny lobsters were released from the surface. The omilu did not show any interest in the lobsters, nor did the lobsters take any evasive action to avoid the fish. The lobsters remained at their landing spot for a short time then moved into one of the numerous holes on this ground.

On dive No. 5 several omilu and a gray reef shark were near the bottom and a small galapagos shark in midwater. The palu bag containing the same chain link weight and 20 spiny lobsters was dropped. As before it did not open on the bottom. It did open about 15 ft up, releasing the lobsters, many of which had lost legs and antennae. Three surface releases of spiny lobsters were made. Neither of the sharks nor the omilu responded to the lobsters. On the third release a single white ulua about 80-90 cm long (perhaps 30-40 lb) came into the area. Two spiny lobsters fell within about 5 ft of the ulua. It showed only mild curiosity but apparently no excitement or predatory behavior. The lobsters continued free falling to the bottom with no tail movements.

On dive No. 6 two gray reef sharks, one galapagos shark, several omilu, and two white ulua were in the general area. A palu bag with a looser slipknot and only a single 3-lb lead weight was dropped with a load of 20 spiny lobsters. The bag opened quickly near the bottom and all of the lobsters escaped without injury. Surface releases of six berried spiny lobsters and one of six slipper lobsters were made. The berried lobsters behaved just as nonberried lobsters had when falling, but seemed to seek shelter more quickly when they reached bottom than nonberried lobsters did. The slipper lobsters, as might be expected, fell through the water column faster than spiny lobsters did, but like the spiny lobsters they fell free with no tail movements. None of the fishes in the area showed anything but casual interest in the free falling lobsters or those released from the palu bag.

On dive No. 7, the first of two made at Nihoa, there were usually two to three reef whitetip sharks and one to three small galapagos sharks in the vicinity. No carangids were seen. A bottom release with the improved palu bag was made with 20 spiny lobsters. The bag opened near the bottom, and most of the lobsters escaped; however, three escaped as the bag was being raised and three arrived at the surface with the bag. A small (125-150 cm) reef whitetip shark was within about 5 ft of the bag when it opened. The shark was quite curious, but showed no predatory interest in the lobsters when they

came out. Eight surface releases including berried spiny and slipper lobsters were made. None of the sharks showed any predatory inclinations.

On dive No. 8, made shortly after the previous dive in the same area, there were three to four small galapagos sharks and three reef whitetip sharks around. A palu bag drop, with 22 spiny lobsters, released nearly all lobsters uninjured at the bottom. The rest came out in midwater. Six surface releases including berried spiny and small slipper lobsters were made. A galapagos shark of about 150 cm did come over and took a close look at the falling lobsters, but did not touch any.

On the morning of June 1, while picking up the last three strings of traps about 4 miles northeast of Necker, there were up to seven 6- to 9-ft galapagos sharks around the ship. These sharks very readily took pieces of lobster trap bait (mackerel) which were thrown overboard. We threw several spiny and two slipper lobsters to them. A number of times the sharks came right up to the lobsters and actually nosed them without taking them. Finally, one shark at a depth of about 20 ft, took a spiny lobster into its mouth. Shortly after a lobster was seen at the surface obviously injured. This was apparently the same lobster that had been taken by the shark, mouthed, and spat out near the surface. Their behavior definitely indicated that these relatively large galapagos sharks were quite hungry. For instance, in addition to eating the mackerel, they tore apart and ate the cardboard cartons in which the mackerel had been packed.

In addition to the visual observations relative to lobster-fish interactions we learned about deficiencies in the palu bag bottom-release system which enabled us to greatly improve its efficiency. Movies and still photos were made of the general operation and fish behavior.

SUMMARY

With the exception of the galapagos shark which (mistakenly) took a spiny lobster into its mouth, none of the fish we observed showed any inclination towards preying on lobsters. Of the fish observed, the data on galapagos sharks and omilu are the most substantial. We had not seriously (due to their size) considered omilu a potential predator on lobsters prior to the experiments and this was corroborated by our observations. Galapagos sharks, which are apparently abundant throughout the NWHI, and certainly were during our observations at Necker, along with tiger sharks, Galeocerdo cuvieri, would both seem to be good candidates as potential lobster predators. This did not prove to be so for galapagos sharks under experimental conditions. Tiger sharks are known predators on lobster. Observations on them would be of value.

Based on somewhat less data, there was no indication that either gray reef sharks or reef whitetip sharks preyed on lobsters.

The three white ulua which were seen in the presence of lobsters certainly did not show any predatory inclinations, but before we can say much about this fish more data are required.

We were unable to make observations on the behavior of schools of large ulua, Caranx ignobilis, and other ulua species or large kahala, Seriola dumerilii, when lobsters were released in their presence. Based on our experience during this cruise, and on word-of-mouth information from participants on previous Townsend Cromwell cruises and commercial vessel cruises to Necker, large schools of carangids rarely if ever occur around that island. If this is so, and considering our observations on sharks, it would appear that surface release of sublegal and berried lobsters by commercial vessels is not likely to be seriously detrimental to the lobster population at Necker Island. This cannot be said for other NWHI areas, such as Maro Reef and Pearl and Hermes Reef, where schools of large carangids are seen more frequently and tiger sharks are probably more abundant.

We learned during this cruise that, given reasonable sea conditions, this type of operation can be efficiently carried out from the Townsend Cromwell. Only a few days of ship time in an area where large carangids and perhaps tiger sharks occur frequently could yield sufficient data to determine whether predation on surface-released lobsters requires further inquiry.

Addendum

Relatively casual observations made during previous Townsend Cromwell cruises in the Northwestern Hawaiian Islands have yielded apparently conflicting information about predation on surface-released lobsters. Two observations recorded in the scientist's log during Townsend Cromwell cruise 77-02 in the spring of 1977 are of interest. One entry reported that northwest of Pearl and Hermes Reef dozens of 25- to 40-kg white ulua were around the traps while the lobsters were being retrieved. When two small spiny lobsters and several small slipper lobsters were tossed back into the water, they were quickly eaten by the fish. On another occasion during the same cruise, while retrieving traps west of Lisianski Island, large numbers of 10- to 30-kg ulua were around the ship. When a small slipper lobster was thrown into the water, the fish merely sniffed it. The records do not indicate whether old bait from the traps was being discarded at the time of these observations or give any information on the state of feeding frenzy, if any, of the fish.

More recently, the National Marine Fisheries Service observer assigned to the commercial fishing vessel Keola during June-July 1979 lobster trapping operations on Maro Reef reported on observations made by himself and crew members of the vessel.

While the Keola was retrieving her traps, old trap bait was continuously disposed of over the side. Simultaneously the observer, who was sampling the lobster catch, tossed the short and berried lobsters back into the sea in the same locality as the discarded bait. During approximately half the time of the operations, large numbers of white ulua and frequently several galapagos sharks were around the vessel. Frenzied feeding was apparent, especially amongst the ulua. On numerous occasions both ulua and sharks were observed to ingest discarded bait and lobsters; however, it was impossible under existing conditions to determine if any lobsters were subsequently spat out.

However, predation was so prevalent that, in an effort to reduce the mortality among the discarded legal lobsters, the precedure was modified. Instead of releasing them while the traps were being retrieved, the lobsters were held in a large tub with flowing water and returned to the sea while the Keola was underway to the next trap site.

Observations such as these seem to indicate that the extent of predation on lobsters released from a vessel may be related to the feeding frenzy of the potential predators. The degree of this frenzy is in turn probably related to variables such as size of the school, size of the fish in the school, feeding state (how close to satiation), and prevailing olfactory and gustatory stimuli. Perhaps even hungry fish require the competition of numbers and/or the strong stimulus of a more favored food such as discarded bait before they will ingest lobsters.